Tactical Technology Office (TTO)

Bradford C. Tousley, Ph.D., Director

Briefing prepared for TTO Office Wide BAA Proposers' Day

May 7, 2014

Mission

The Defense Advanced Research Projects Agency (DARPA) was established in 1958 to **prevent strategic surprise** from negatively affecting U.S. national security and **create strategic surprise** for U.S. adversaries by maintaining the technological superiority of the U.S. military.

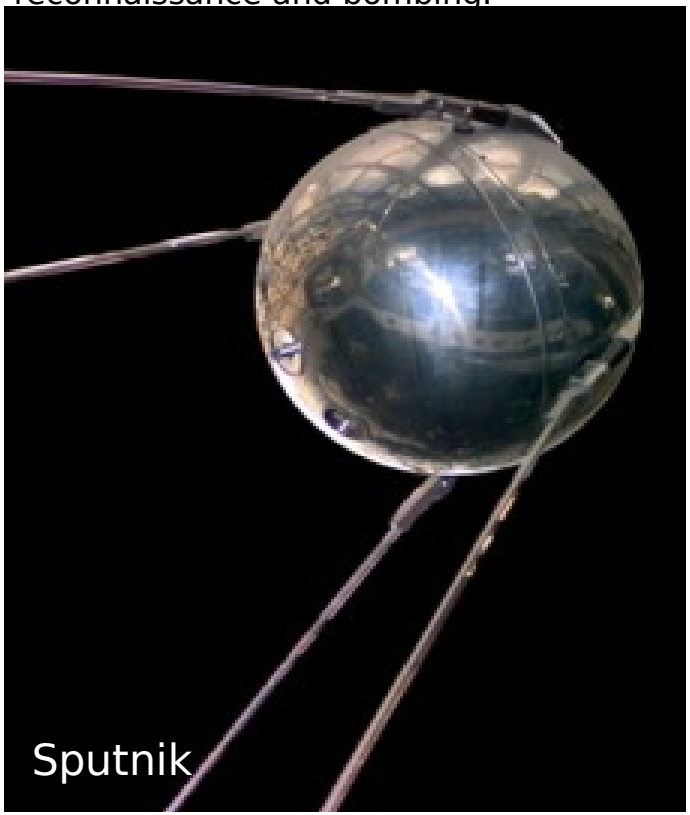
To fulfill its mission, the Agency relies on **diverse performers** to apply multi-disciplinary approaches to both advance knowledge through basic research and **create innovative technologies** that address current practical problems through applied research.

As the DoD's **primary innovation engine**, DARPA undertakes projects that are finite in duration but that create **lasting revolutionary change**.

DARPA

1 9 5 7

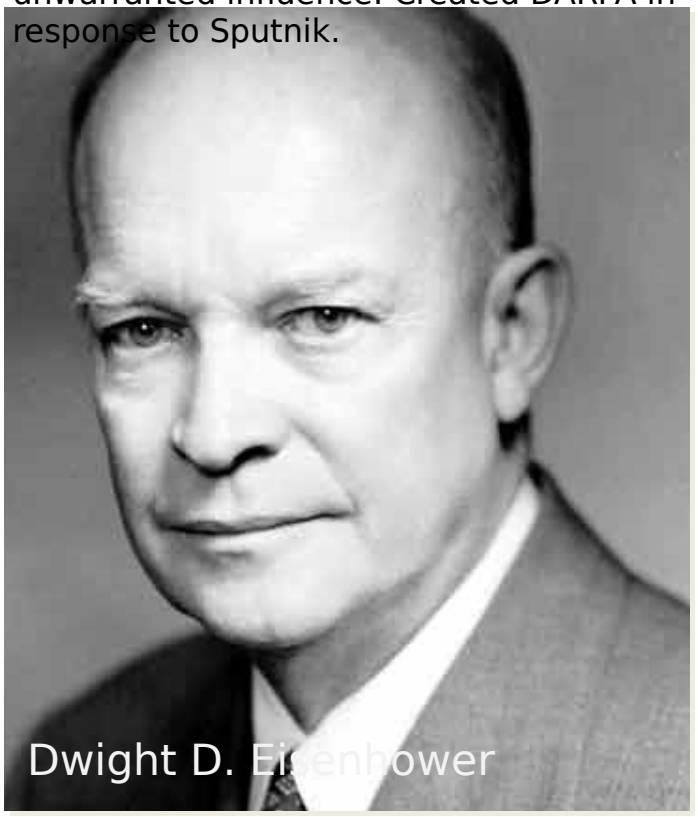
First orbiting satellite. The satellite was not a threat, but the level of technology indicated that the Soviet Union possessed superior capability for intercontinental reconnaissance and bombing.



Sputnik

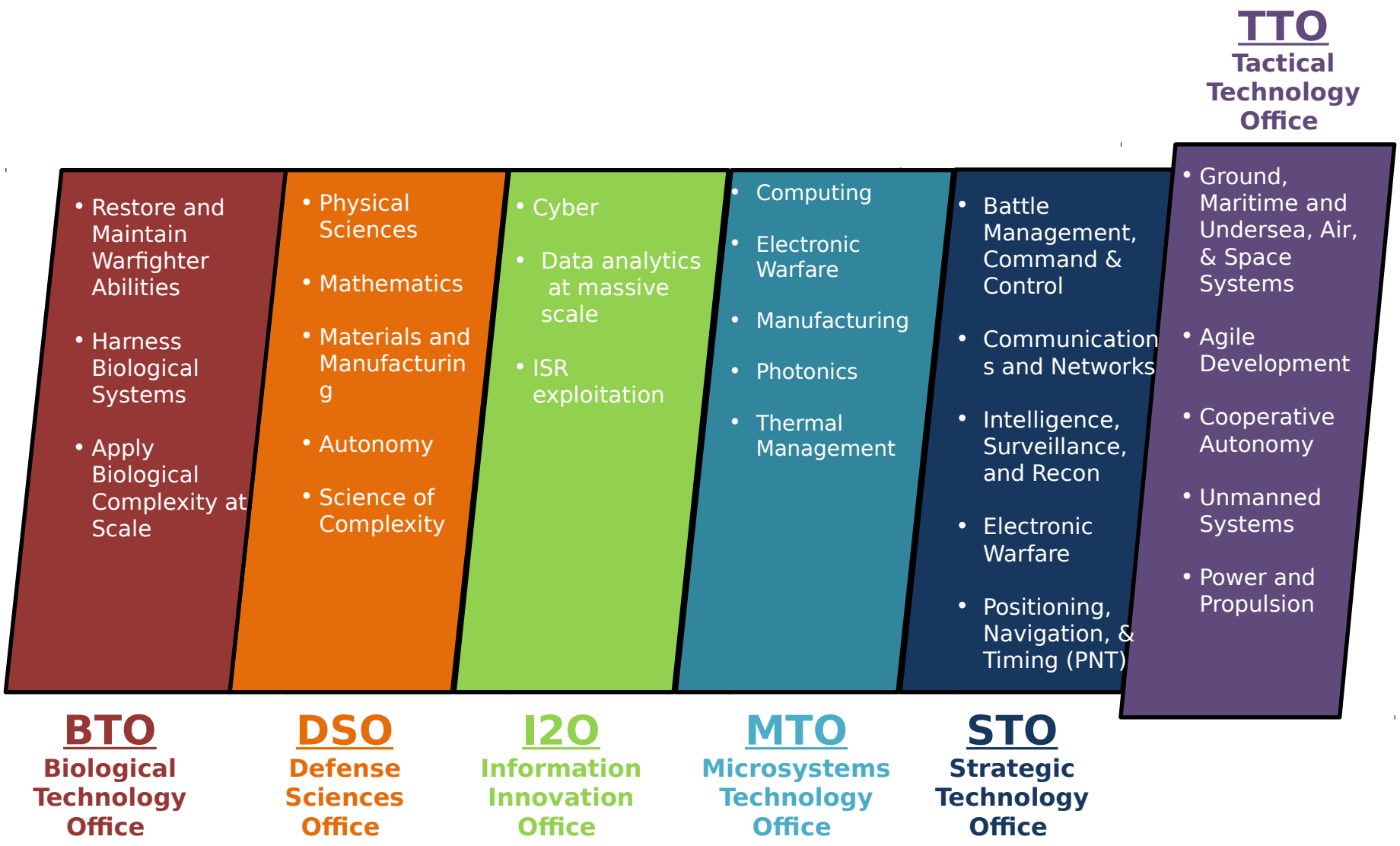
1 9 5 8

34th President of the United States 1953-1961.
Coined the term “military-industrial complex” and warned against its unwarranted influence. Created DARPA in response to Sputnik.



Dwight D. Eisenhower

DARPA technical offices



Tactical Technology Office (TTO)

Vision

TTO will rapidly develop new prototype military capabilities that create an asymmetric technological advantage and provide U.S. forces with decisive superiority and the ability to overwhelm our opponents

Objective

To provide or prevent strategic and tactical surprise with very high-payoff, high-risk development of revolutionary new platforms, weapons, critical technologies and systems, approaches addressing affordability, as well as rapid agile development

Cross Cutting Themes

Agile development approach, cooperative autonomy, unmanned systems, power and propulsion

System Focus Areas

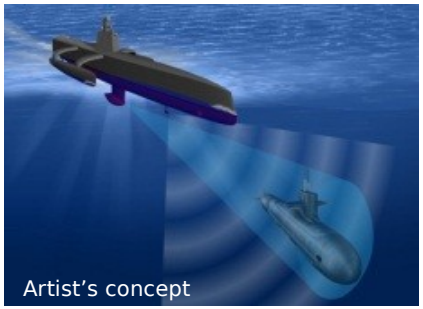
Ground Systems

Amplify unit / soldier effectiveness

Artist's concept

Maritime and Undersea Systems

Control the sea, influence events on land



Artist's concept

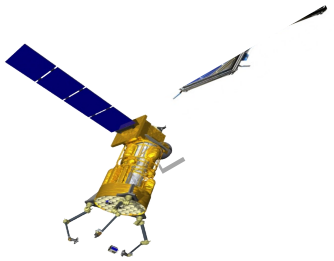
Air Systems

Control the air anytime / anywhere

Artist's concept

Space Systems

Normalize and simplify space



Artist's concept

TTO legacy – a reminder

Ground Systems


1967
M16 (Project Agile)


1978
Tank Breaker


1982
Army Tactical Missile System (Assault Breaker)

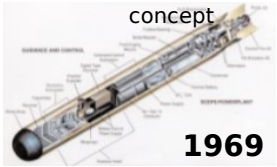

2002
Talon


2003
Boomerang


2003
Netfires


2008
BigDog

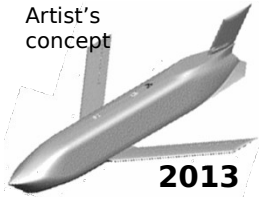
Maritime and Undersea Systems

Artist's concept

1969
MK 50 Torpedo Propulsion System


1984
Sea Shadow

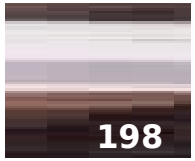

1988
Unmanned Undersea Vehicle (UUV)


1992
Submarine Technology (SUBTECH)

Artist's concept

2013
Long Range Anti-Ship Missile (LRASM)

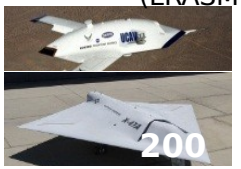
Air Systems


197
Have Blue 7


198
Tacit Blue

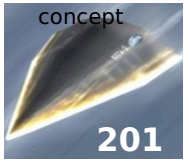

1990
X-31


1998
Global Hawk

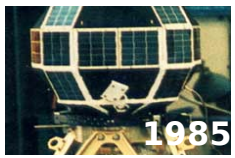

200
X-45/46/47


200
A-160

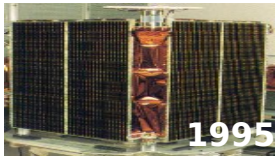

2011
Damage Tolerant Controls (DTC)

Artist's concept

201
Falcor. HTV-2

Space Systems

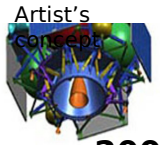

1985
Global Low Orbiting Message Relay (GLOMR)


1990
Pegasus


1995
DARPASAT


1997
Taurus


2003
Falcon Small Launch Vehicle

Artist's concept

2006
MiTEX


2007
Orbital Express (OE)


2013
Space Surveillance Telescope (SST)

The environment

Threats

- Broad spectrum
- Rise of peer threats
- Global (tactical / strategic)

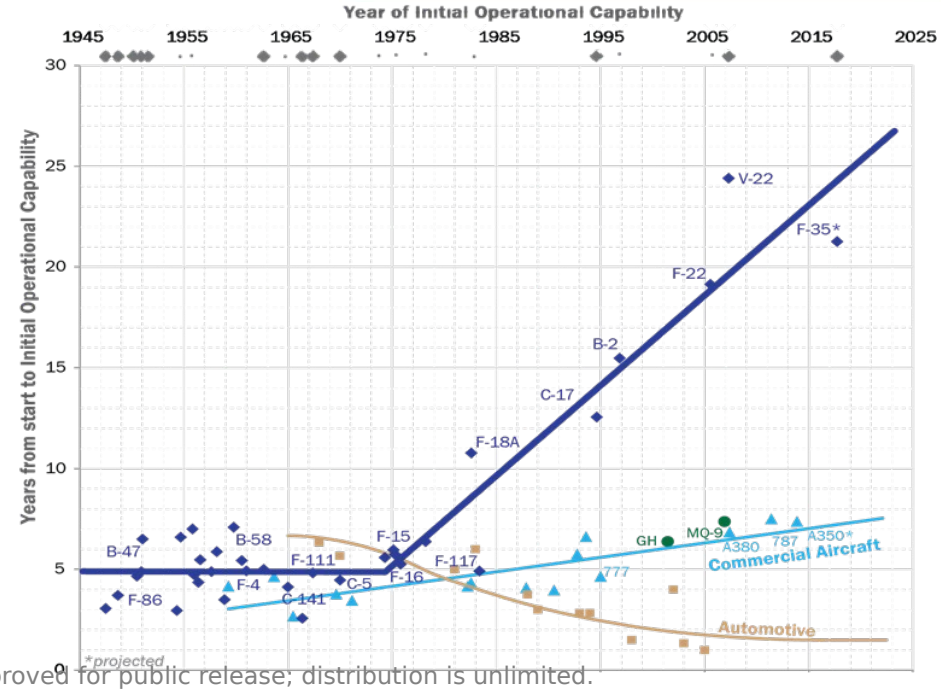
Environments

- Denied, congested, contested
- Countermeasures
- Extreme range / distance

Cost and technology challenge

- Rapid and expansive threat modernization
- Long U.S. development cycles of complex systems (smaller base and increased costs)
- Medium technology swarms (UAS, information, countermeasures)

Source: en.wikipedia.org



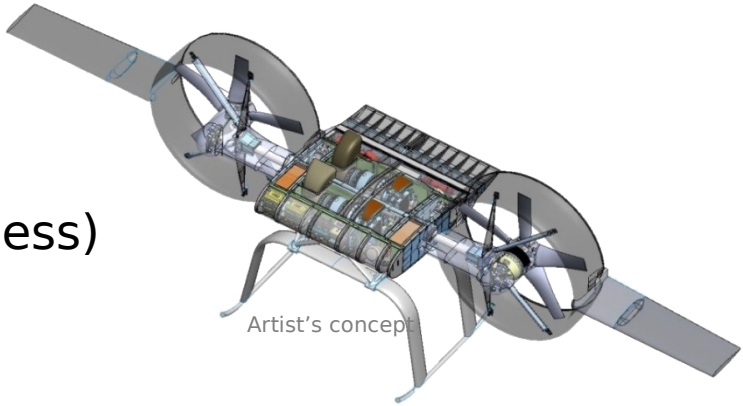
Source:

Source: www.offiziere.ch

Source: defense-update.com

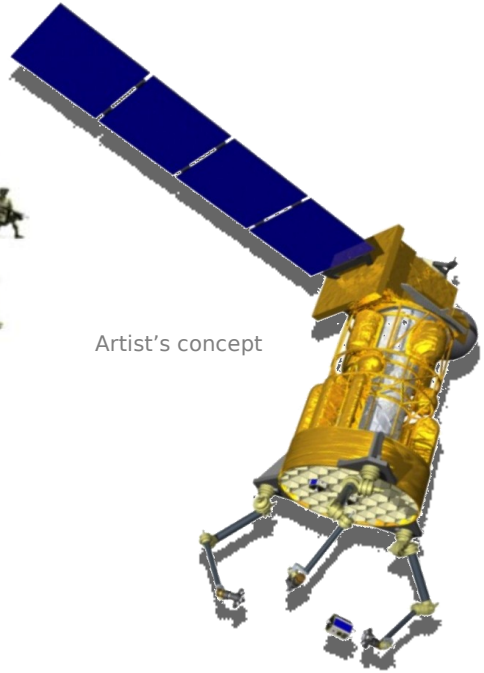
Tenets of our programs

- Big wins; decisive superiority
- Demonstrating prototypes
- Unmanned leverage (maximize effectiveness)
- Drive cost-effectiveness (system and countermeasures)
- Agile program execution


Artist's concept


Artist's concept


Artist's concept

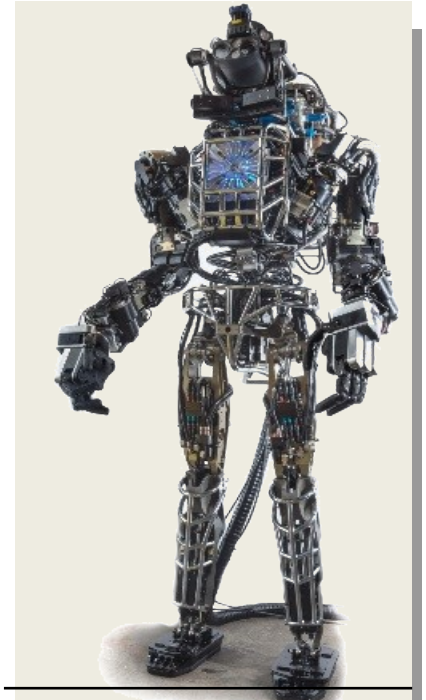

Artist's concept


Artist's concept

What we ask of our program managers

- Accept risk for high payoffs…and know the difference
- Don’t be upset with failure; be upset with failing to try
- Know the business case and capabilities
- Focus on rapid execution and performer competition through PDR/CDR
- Expect the A-team from performers

Ground Systems



DARPA Robotics Challenge
Dr. Gill Pratt

Squad X
MAJ Christopher Orlowski
Artist's Concept

Amplify unit/Soldier effectiveness

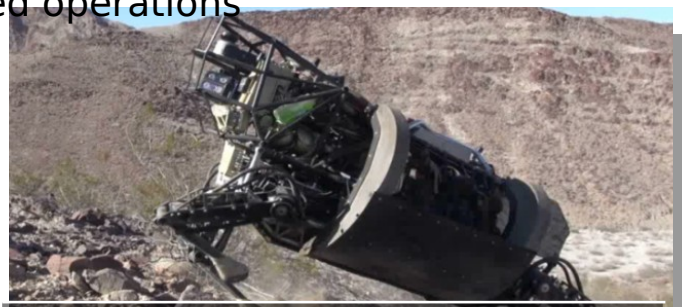
Technical goals

- Lethality overmatch and scalable effects
- Agility and mobility
- Reduce footprint
- Manned and unmanned operations
- ns

Artist's Concept

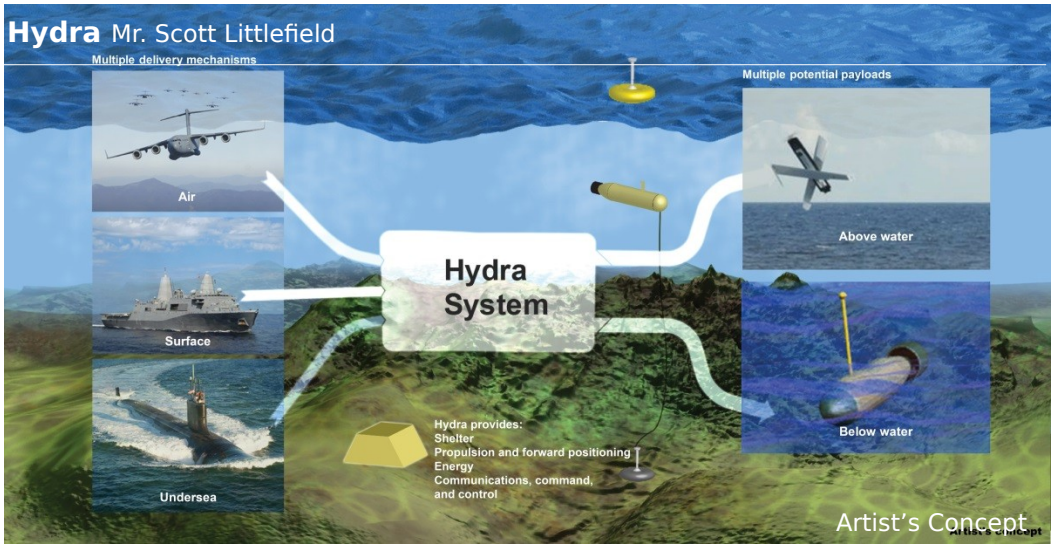
EXACTO Mr. Jerome Dunn

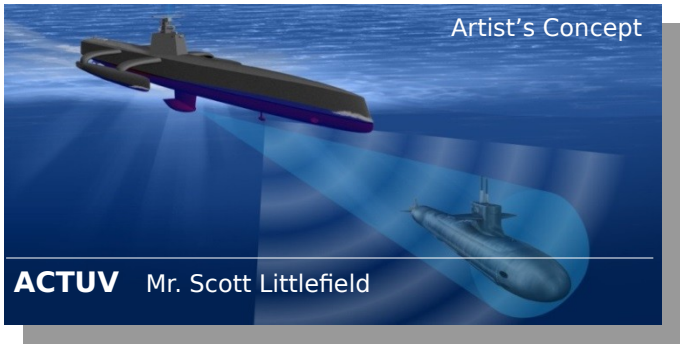
Persistent Close Air Support (PCAS)
Dr. Daniel Patt
Artist's Concept



Legged Squad Support System (LS3)
MAJ Christopher Orlowski

Maritime and Undersea Systems



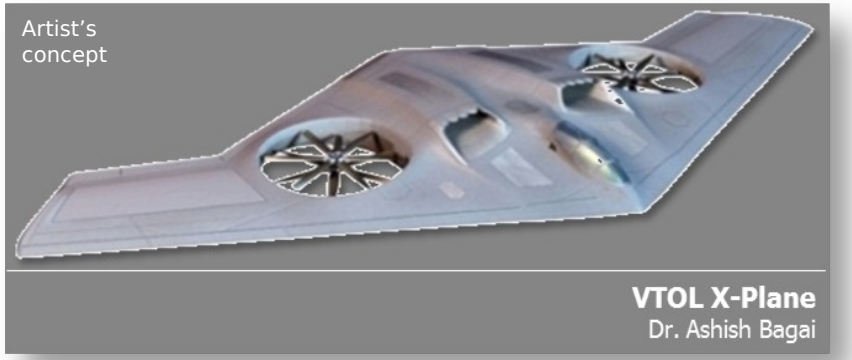


Control the sea, influence events on land

Technical goals

- Situational awareness/threats
- New capabilities (asymmetric, affordable, precise, extended range)
- ~~Strike (asymmetric, affordable, precise, extended range)~~
- High-value asset protection

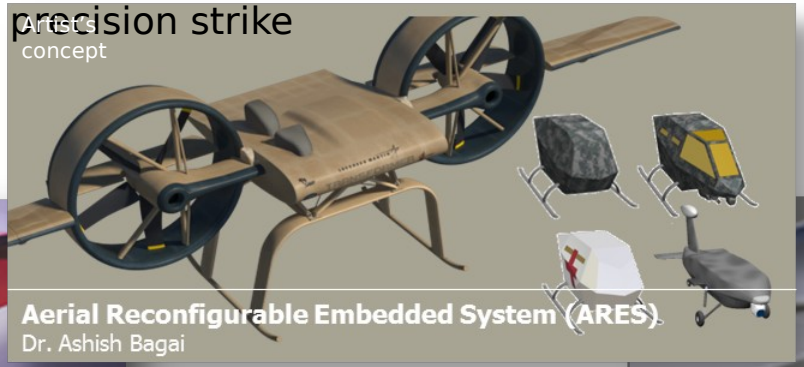
Air Systems

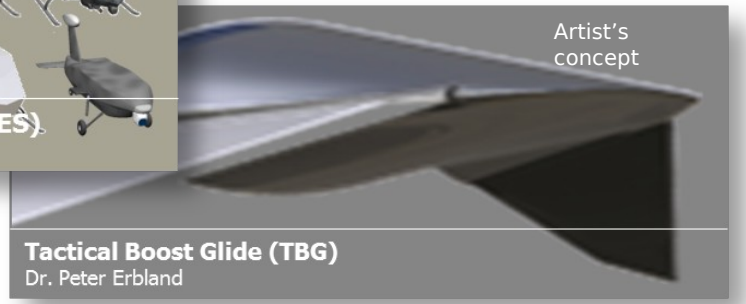


Control the air anytime/anywhere

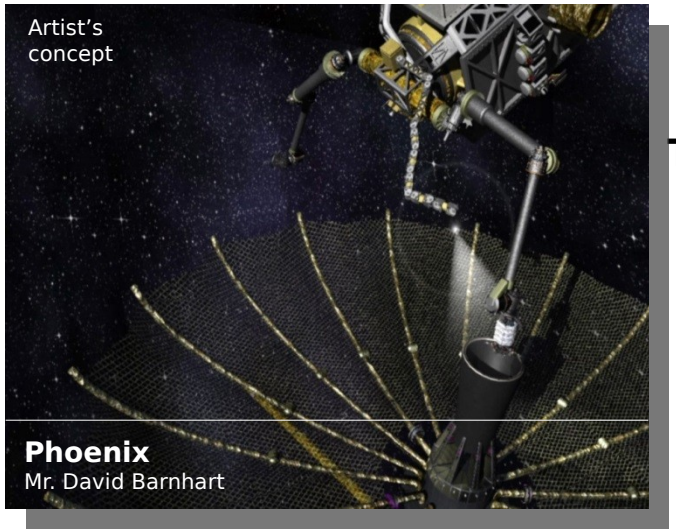
Technical goals

- Extend performance envelope (speed, range, payload, endurance, survivability)
- Address the tyranny of distance
- Advanced propulsion and power systems
- High-speed precision strike





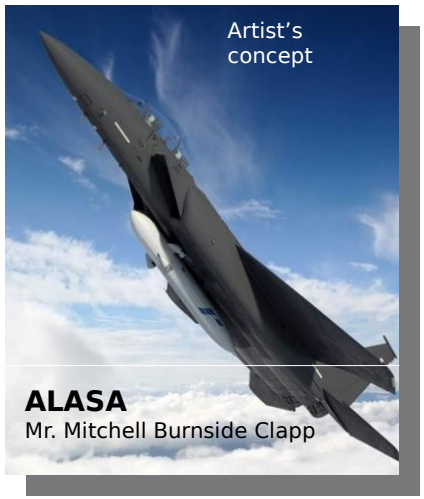
Space Systems

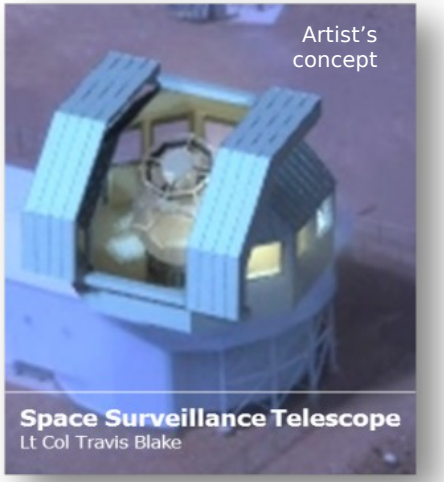


Normalize and simplify space

Technical goals

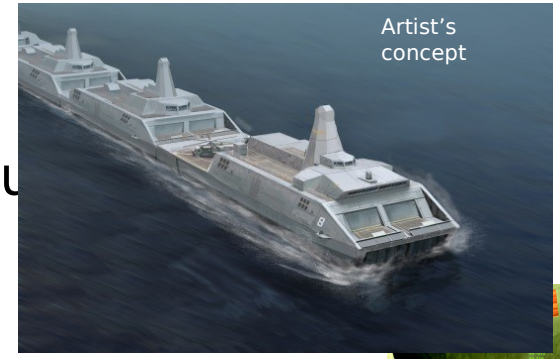
- Affordable routine access
- Reduce escalating systems cost
- New capability
- Survivability / resilience / reconstitution / autonomy
- Disaggregation/simplification
- Space situational awareness

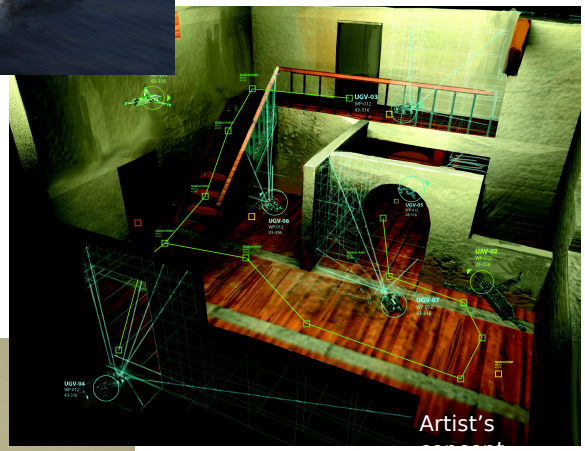


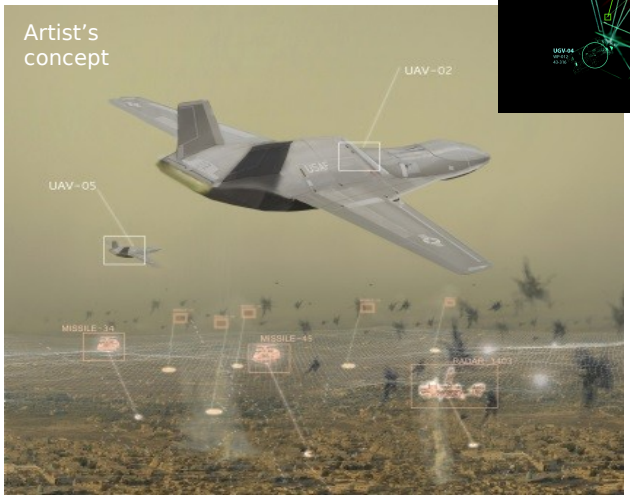


Areas / concepts to consider

- Small engine challenge
- Large persistent space structu
- Advanced power systems
- Swarm and counter swarm
- Strategic mobility
- UAV truck







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Tactical Technology Office: Office Wide BAA

Pamela A. Melroy, Deputy Director

Briefing prepared for TTO Office Wide BAA Proposers' Day

May 7, 2014

Why are we here today?

- We want to make sure that you understand our approach including:
  - The areas we are focusing on and why, so that you can be more effective in what you propose
  - Our process and the realities about the way our Office Wide BAA works
- We want to answer your questions:
  - During tomorrow's sidebars, tell us your ideas for truly revolutionary technologies that are aligned with the PMs' vision
  - Tell us your thoughts on how we can tap into new ideas that can strengthen our existing programs
- The interchange of ideas between DARPA and industry has always been at the heart of TTO's approach to developing revolutionary technologies:
  - Many programs have started as seedlings from office-wide BAA submissions

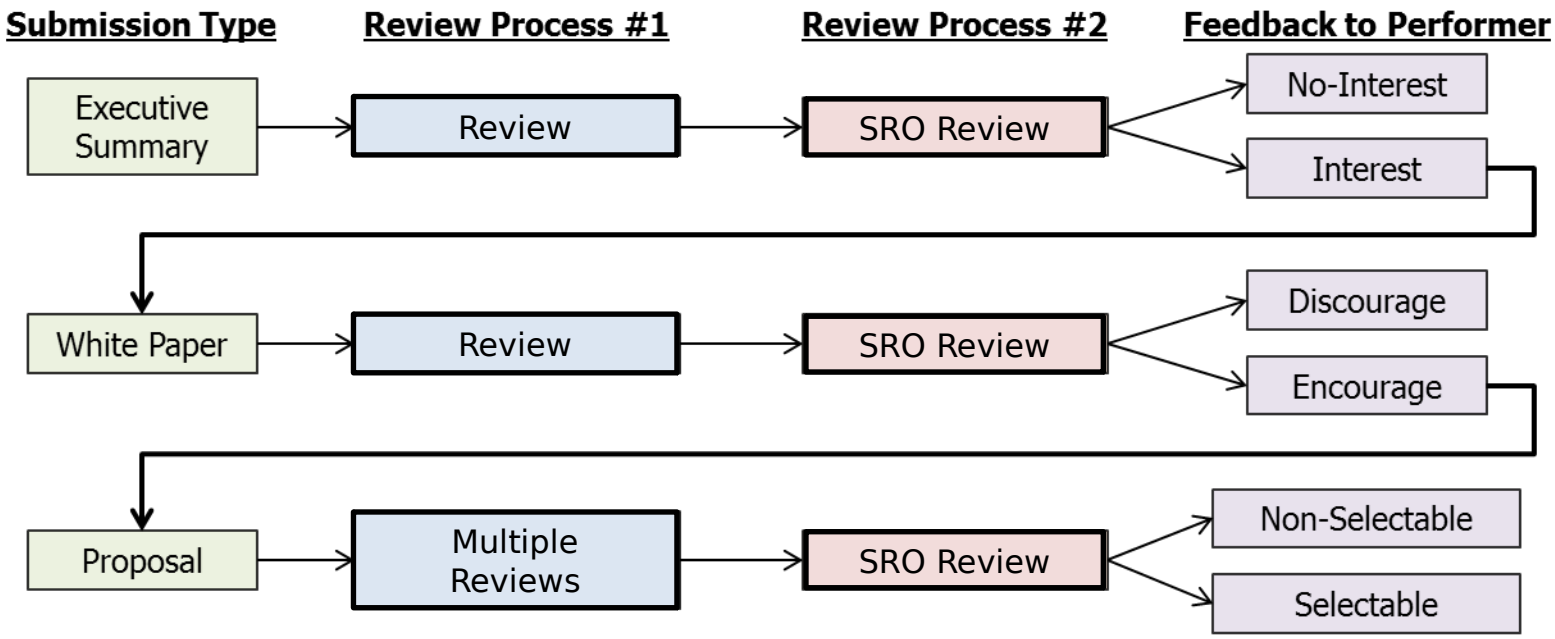
Our engine is made up of our PMs' visions

- Program Managers are the ones who execute seedlings and programs
  - Office Director and Deputy Director can help you locate the right PM
- You may have a good idea, but if it's not aligned with someone's interest area, then it won't happen
- Feedback for Executive Summaries and White Papers can steer you in the right direction before submitting a proposal

How does it work?

- One (1) year-long Office-Wide BAA:
  - Designated BAA coordinator and email address
  - Does not supersede program BAAs

- Executive Summaries, White Papers, and Proposals



Things to keep in mind (1 of 3)

- No-Interest/Discourage means:
  - In the form you submitted, we are not interested in your idea because:
    - The submission does not present an approach to developing technology that is aligned with the DARPA/TTO Focus Areas and interests
    - The submission is not important to TTO's areas of responsibility as outlined in the BAA
    - The submission is not suitably structured to produce a TTO systems level demonstration or product
    - The submission does not substantiate a revolutionary military capability within the TTO portfolio
    - The proposed approach does not clearly identify current limitations that will be overcome
    - The submission does not identify barriers to implementing new operational concepts and postulates solutions
    - The submission does not convey technology significantly beyond the state of the art
  - It does NOT mean that you cannot resubmit after changing your concept or that you cannot submit a full proposal… BUT chances of success are extremely slim

Things to keep in mind (2 of 3)

- Common misunderstandings:
  - You can submit any time in the period, not just at the due date
  - There is a short “blackout” period on executive summaries and white papers near the end – don’t panic, just wait for our next BAA to come out
  - Make sure it is relevant to TTO ~~– the platform and propulsion office!~~ Your idea may be more relevant for another DARPA Office
  - Please explain your technology that enables a new capability
  - Don’t forget to tell us what you want – a study? a demo? and what you will deliver
  - Do your homework – how is the task accomplished today and how much will your technology compare in cost, performance, and operations?
  - Not all this detail is needed in an executive summary, but you should have considered this when submitting

Things to keep in mind (3 of 3)

- Interest/Encourage means:
  - We find your idea interesting and we would like to know more
  - It does NOT mean that you are funded or that a full proposal will be accepted

- Funding expectation:
  - Intent is to fund seedlings at < $1M
  - Okay to propose options for a larger follow-on program
  - Efforts larger than seedlings are likely to be handled as a program – options or through a program BAA

Do and don’ts

- DO read the BAA-14-25 document in its entirety
- DO use the executive summary and white paper process
- DO forward any questions related to the DARPA/TTO Office Wide BAA-14-25 to DARPA-BAA-14-25@darpa.mil

- Do NOT recirculate proposals rejected from program BAAs
- Do NOT hand carry paper copies to the DARPA building
- Do NOT email/fax in your executive summary, white paper, or proposal to the BAA-14-25 mailbox
- Do NOT call to check on the status of your submission

Questions?

- How can we improve the process?*

*...please don’t ask us to change the Federal Acquisition Regulations!

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TTO Office Wide Proposers' Day 2014

Mr. Jerome Dunn

Briefing prepared for TTO Office Wide BAA Proposers’ Day

May 7, 2014

Mr. Jerome Dunn

Program Manager, Tactical Technology Office (TTO)

B.S. Biomedical Engineering, Johns Hopkins, 2000
M.S. Electrical Engineering, Johns Hopkins, 2004
Ph.D. Systems Engineering, George Washington, 2016 (expected)

Program Manager, DARPA/TTO 2013 – Present

- Precision Strike/EXACTO
- Looking to blur the lines between missiles and bullets

S&T Programs Officer, Naval Sea Systems, 2011 – 2013

- Surface and Subsurface Technology Transition and International Outreach
- Transitioned and integrated technologies for LCS, Virginia Class, CVN and various surface craft platforms

Associate Director, Office of Naval Research Global, 2008 – 2011

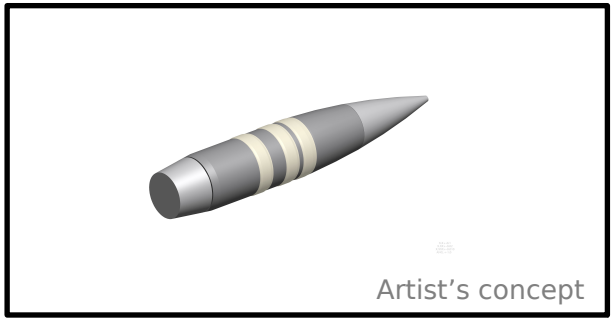
- Unmanned Systems and Underwater Weapons/Power Projection
- Sponsored technology projects throughout Asia and provided Global Technology Awareness

Test and Evaluation Manager, Naval Sea Systems, 2006 – 2008

- Littoral and Mine Warfare T&E
- Provided T&E oversight for various Littoral and Mine

Existing TTO programs

- Extreme Accuracy Tasked Ordnance (EXACTO)
  - The EXACTO system seeks to improve sniper effectiveness and enhance troop safety. The objective of the EXACTO program is to revolutionize rifle accuracy and range by developing the first guided small-caliber bullet. The system combines a maneuverable bullet and a real-time guidance system to track and deliver the projectile to the target, allowing the bullet to change path during flight to compensate for any unexpected factors that may drive it off course.
  - Currently seeking direct transition of EXACTO and also leveraging the technology for larger caliber applications across the services such as Navy ship self defense.


Artist's concept

Interest Areas

- MAD-FIRES: Defeat of supersonic anti-ship cruise missile (ASCM) raids using a gun system
- Anti-swarming
- Mine detection

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TTO Office Wide Proposers' Day 2014

Lt. Col. Larry Gunn

Briefing prepared for TTO Office Wide BAA Proposers’ Day

May 7, 2014

Lt. Col. Larry Gunn

Program Manager, Tactical Technology Office (TTO)

B.A. in Mechanical Engineering, Brigham Young University, 1994

M.B.A, Webster University, 2002

M.S. in Systems Engineering, AFIT, 2009

Program Manager, DARPA/TTO 2013- Present

Chief, Space Protection and IO Requirements Div, HQAFSPC, 2010 - 2012

- Requirements development for Space Protection
- Co-led ANSCC Study with USSTRATCOM

Director of Ops, NRO Cape, Office of Space Launch, 2005-2009

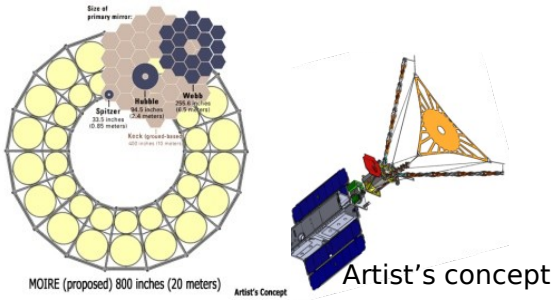
- Launch base processing for NRO satellites from Cape Canaveral

Mission Manager, NRO, Office of Space Launch, 2002-2005

- Last Titan IV-B Mission and other EELV missions

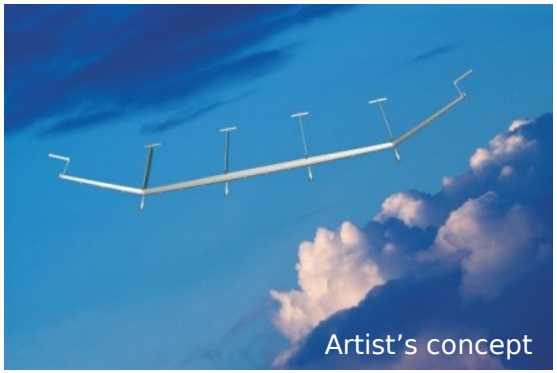
Existing TTO programs

- Membrane Optical Imager for Real-Time Exploitation (MOIRE)
  - MOIRE seeks to diffract light with transmissive Fresnel lenses made from a lightweight membrane roughly the thickness of household plastic wrap



Artist's concept

- Vulture – High Altitude Long Endurance
  - Advancing critical energy management technologies—solar collection (photovoltaics) and fuel cells (energy storage systems)


Artist's concept

Interest areas

- Space and Near Space Platforms
  - Enabling the high ground advantage
- Taking space domain awareness to the next enabling level
- Space Protection

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TTO Office Wide Proposers' Day 2014

Mr. Jean-Charles (JC) Ledé

Briefing prepared for TTO Office Wide BAA Proposers’ Day

May 7, 2014

Mr. Jean-Charles (JC) Ledé

Program Manager, Tactical Technology Office (TTO)

B.S. in Mathematics (French Equivalent), 1990
M.S. in Aeronautics (French Equivalent), 1993

Program Manager, DARPA/TTO 2013- Present

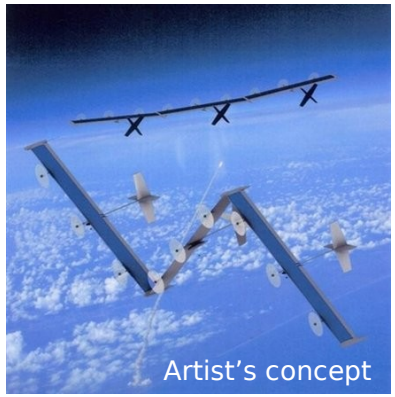
- Autonomy in aerial systems
- Counter Unmanned Air Systems (UAS) and counter swarms
- High performance vehicles

Director Autonomous Systems, Raytheon Missile Systems 2010-2013

- Expanding mission set for RMS products
- Programs included PCAS, STM, ALTA, SOTHOC

Aurora Flight Sciences 1993-2010

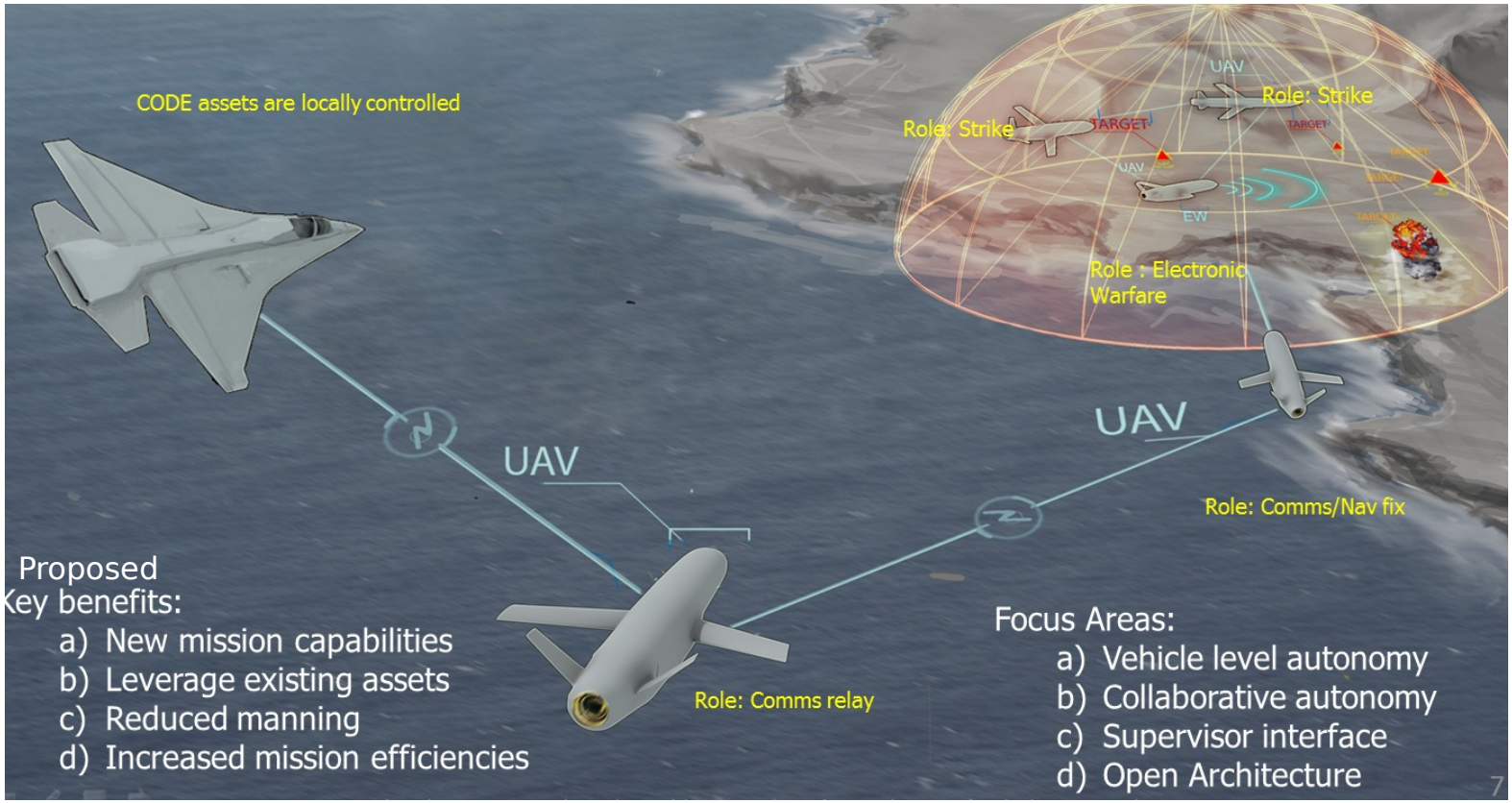
- Intern to VP for Advanced Concepts
- Contributed to design of >20 aircraft including
  - Orion
  - Vulture
  - MarsFlyer
  - CUAV
  - LAM
  - UCAV
  - Chiron



Existing TTO programs

Collaborative Operations in Denied Environment (CODE)

Code seeks to develop and demonstrate the algorithms to expand the mission capabilities of legacy assets through autonomy and collaborative behaviors



Interest areas

- Autonomy for Aerial Vehicles
  - Improved perception
  - Collaboration among heterogeneous vehicles
- Advanced flight controls
  - Fault tolerant/Adaptive
  - Multi-vehicles in close formation or connected
- Advanced vehicle configurations or critical airplane subsystems that improve mission performance by an order of magnitude
- Counter UAS
  - Detect, Identify, Neutralize
- Counter swarm
  - Low cost, robust neutralization mechanisms
- Precision strike in urban terrain
  - 3D targeting
  - Highly maneuverable munitions
- Any ideas to reduce the time to deploy new DoD capabilities by ~2 orders of magnitude

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TTO Office Wide Proposers' Day 2014

Dr. Kevin Massey

Briefing prepared for TTO Office Wide BAA Proposers’ Day

May 7, 2014

Dr. Kevin Massey

Program Manager, Tactical Technology Office (TTO)

B.A. in Aerospace, Ga Tech, 1992
M.S. in Aerospace, Ga Tech, 1994
Ph.D. in Aerospace, Ga Tech, 1997

Program Manager, DARPA/TTO 2013- Present

- Smart Munitions
- Vehicle Survivability

Professor and Department Head, Royal Melbourne Institute of Technology, 2010 - 2013

- Systems Engineering, UAV Course

Senior Research Engineer, GTRI, 2000 - 2010

- Guided Bullets
- Vehicle Survivability
- UAS Signatures
- Acoustics

Noise Lead, Pratt & Whitney/Large Military Engines, 1998 - 2000

- Jet Noise
- Engine Signatures

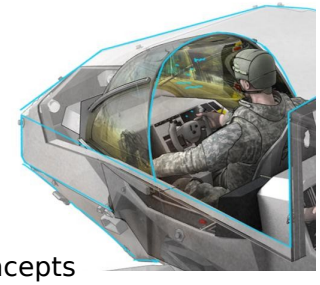
Program Engineer, Ford Motor Company, 1997 - 1998

Existing TTO programs

- **Adaptive Vehicle Make (AVM)**
  - A portfolio of programs that aims to compress the development timelines for new complex cyber-physical systems by at least five-fold

Artist's concept

- **Ground X-Vehicle (GXV) Technologies**
  - New program which will push four technology areas to improve expeditionary mobility without sacrificing survivability



Artist's concepts

- **Magneto Hydrodynamic Explosive Munition (MAHEM)**
  - Demonstrate flux compression generator based warhead with greater lethality and penetration than present warheads

Interest areas

- Vehicle Survivability
  - Ground and Air Vehicles
  - It’s easier to make holes
- Advanced Armor Concepts
  - Not just material science, but new ways of defeating in bound threats
  - We need force fields – Active Protection System (APS) ~~but without Fratricide~~
- Advanced Munitions
  - Guided 40mm Grenades
- Advanced Warheads
  - Lots of tech out there – dial-a-yield, new energetics, reactive frags, directional blast, printable frag collars, printable explosives, multipoint initiation, MEMs fuzes
  - Put in a pot, add HE, and stir - let’s make a cool warhead together
- Gunships
  - Can we make Apache’s and AC-130 guns more lethal?
- All weather small unmanned air systems (SUAS)

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TTO Office Wide Proposers' Day 2014

Maj. Christopher Orlowski

Briefing prepared for TTO Office Wide BAA Proposers’ Day

May 7, 2014

Maj. Christopher Orlowski, Ph.D.

Program Manager, Tactical Technology Office (TTO)

B.S. in Mechanical Engineering, United States Military Academy, 2002

M.S. in Astronautical Engineering, University of Southern California, 2006

Ph.D. in Aerospace Engineering, University of Michigan, 2011

Program Manager, DARPA/TTO March 2014 - Present

- Warrior Web, and Legged Squad Support System
- Manned and unmanned teaming in complex environments, biomimetic unmanned system, performance and capability of dismounted ground forces

Assistant Product Manager, Robotic Systems Joint Project Office, October 2012 – March 2014

- M160 Anti-Personnel Mine Clearing System, Squad Mission Equipment Transport
- Man Transportable Robotic System Inc II, Talon Family of Systems

Officer in Charge and S&T Liaison, Joint Robotics Repair Detachment - Afghanistan, April 2012 – September 2012

- Ultra Light Recon Robotics Forward Operational Assessment

Existing TTO programs

- **Legged Squad Support System (LS3)**
  - LS3 seeks to demonstrate that a highly mobile, semi-autonomous legged robot can carry 400 lbs of a squad's load, follow squad members through rugged terrain and interact with troops in a natural way, similar to a trained animal and its handler.

Interest areas

- Robust autonomy for UxS in complex, dynamic environments
- Near real-time multi-modal sensor fusion and exploitation
- Precision fire capability at the squad level
- User interfaces that reduce the cognitive and physical burden on individual Soldiers and Marines

- **Potential Program: "**Squad X" seeks to develop a system of systems to organically extend the dismounted infantry squad's awareness and influence

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TTO Office Wide Proposers' Day 2014

Dr. Gordon Roesler

Briefing prepared for TTO Office Wide BAA Proposers’ Day

May 7, 2014

Dr. Gordon Roesler

Program Manager, Tactical Technology Office (TTO)

B.S. in Physics, U.S. Naval Academy, 1975
Ph.D. in Physics, MIT, 1992

Program Manager, DARPA/TTO 2014- Present

Engineer, UNSW ACSER, 2012-2013

- Radar satellite for Australian soil moisture
- Off-Earth resources recovery
- Oscar

Director of Energy Info, USC ISI, 2009-2011

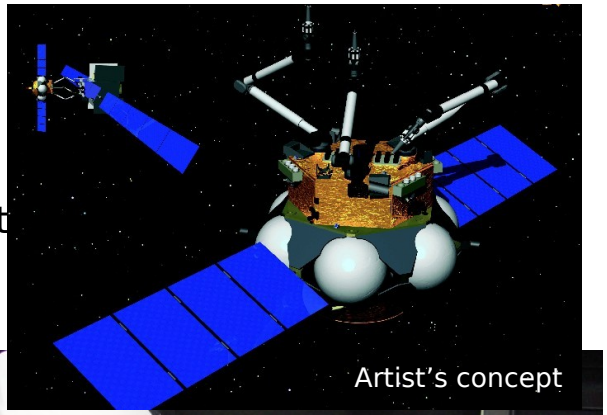
- Smart Grid, Energy Informatics
- PI for F6 project
- US patent for energy storage system

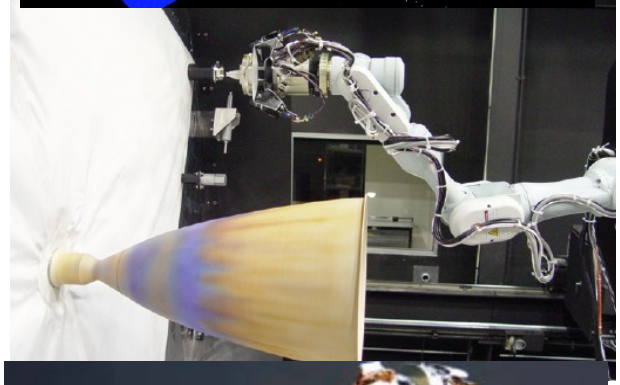
Physicist, SAIC Ocean Systems, 2007-2009

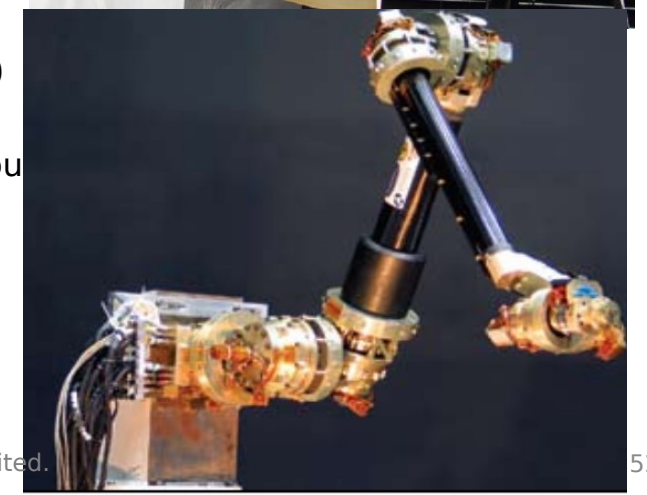
- Unmanned boat autonomous steering
- Chemical-powered underwater sound sou
- Diving systems

Program Manager, DARPA/TTO 2002-2006

- SUMO & FREND
- Deep View
- INSPACE



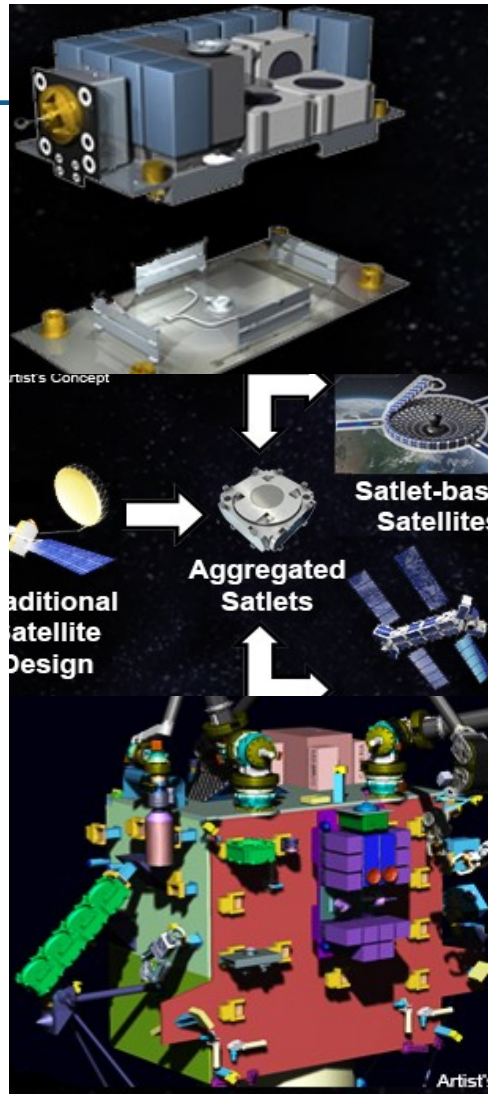




Existing TTO programs

- Phoenix
  - Introduction of robotics capabilities in GEO
  - Improved satellite usefulness, lifespan, resilience and reliability
  - Lower satellite construction and deployment costs
  - Flexibility to accommodate multiple mission-critical on-orbit servicing missions (i.e. refueling, repair, repurposing, repositioning, etc.)

- Possible new missions:
  - Orbit adjustment
  - Inspection of failed components
  - Deployment anomaly correction
  - Deferred disposal



Interest areas (1 of 2)

- Robotic assembly of large apertures
  - Military advantages (better link margin, smaller ground terminals, improved intercept, persistence at GEO, etc.)
  - Phoenix plans to provide prototype assembler
  - Implementation

- Autonomy plus optimal human-robot interactions

Technologies that make robotic assembly approaches practical

Interest areas (2 of 2)

- Orbital debris in LEO
  - AF tracks 20,000 objects
  - Estimated total number 500,000 of 1cm size or greater
  - *Becoming an impenetrable "wall" at LEO*

- Future Space Operations
  - Recently declassified Geosynchronous Space Situational Awareness Program (GSSAP) will greatly enhance situational awareness at GEO
  - What are optimal responses to that awareness?
  - What technologies will improve responses?

Optical detection approaches for debris in Cubesat, smallsat, or hosted payload format

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